SECRET

NPIC/TSSG/ESD/EL-3[illegible]/69
24 April 1969

MEMORANDUM FOR: Director, National Photographic Interpretation Center

SUBJECT: Request for Approval of Change in Scope Amounting to [redacted] from FY 69 R&D Funds for Contract No. [redacted] Task 37 with [redacted] 25X1 25X1

1. This memorandum requests approval for the commitment of funds to be added to a current Research and Development contract with [redacted] The specific request is stated in paragraph 5. 25X1

2. Isodensity contour analysis of certain targets has proved valuable in the past; however, it is tedious, time-consuming and often a nonproductive process. The Image Quantizer was developed by [redacted] in the Image Analysis Program to speed up the process. Another set of devices called "shaded apertures" have also been developed by [redacted] in the Image Analysis Program which tend to ease setup of the device and provide a more easily interpretable output. A mating of the shaded apertures to the Image Quantizer would provide a fast, relatively easy-to-use isodensity contouring device. 25X1 25X1 25X1

3. The proposed effort will design a range of shaded apertures to be used in the Image Quantizer in different situations, check the operation of these apertures and develop guidelines to regulate their use. The basic time frame is one month to design and fabricate the filters and three months to test them and develop a specific rationale for their use. Successful completion of the project will result in delivering a set of shaded apertures compatible with the Image Quantizer, with appropriate documentation.

SECRET

GROUP 1
Excluded from automatic downgrading and declassification

SUBJECT: Request for Approval of Change-in-Scope Amounting to [redacted] from FY 69 R&D Funds for [redacted] 25X1
Task 37 with [redacted] 25X1

4. The technology necessary to build the devices has been developed by [redacted] and they are the only organization suited to meeting this requirement within the time and funds requested. 25X1

5. It is requested that the negotiation for a change-in-scope to the current contract with [redacted] be approved 25X1
at a cost not to exceed [redacted] 25X1

[redacted]
Chief, Technical Services & Support Group
NPIC

Attachments:
1. [redacted] Proposal 25X1
2. Definition of "shaded apertures"

APPROVAL: [redacted] 9 MAY 1969 25X1
ARTHUR C. LUNDAHL Date
Director
National Photographic Interpretation Center

Distribution:
Original - NPIC/TSSG/SSD/LB (After Approval)
1 - NPIC/ODir
1 - NPIC/TSSG
1 - NPIC/TSSG/SSD
1 - NPIC/TSSG/DED

DEFINITION OF "SHADED APERTURES"

1. The term "aperture" refers to an opening through which light passes. The opening may be of any shape or size. It is usually not symmetrical for this application.

2. The photographic image is made up of microscopic silver grains. The image itself can be detected by averaging the grain structure over a suitable area. If the aperture is too small, the resulting sample contains too much noise and may obscure the signal. If the aperture is too large, the averaging suppresses noise but also suppresses information. The region between these two extremes of aperture size is very narrow and difficult to define. The shaded aperture provides a weighted average which tends to discriminate against the noise while allowing the signal to pass. The effect of the shaded aperture is therefore to smooth the data with a minimum loss of the signal. In some cases, this results in an apparent resolution increase.

7 April 1969

PROPOSAL TO CONSTRUCT SHADED APERTURES FOR THE IMAGE QUANTIZER

Experience in the operation of the Image Quantizer has shown that grain noise is often a problem in traces made with this instrument. It is therefore possible that shaded apertures would improve the operation of the I.Q. Inasmuch as the I.Q.-Projection Printer system is suitable for quick response to a variety of photointerpretation tasks, the use of shaded apertures should be compatible with this capability. Experience in using Wiener shaded apertures for various film types has shown that Wiener apertures yield results that are not noticeably better than results obtained with properly scaled Gaussian apertures. We therefore propose the following program leading to the use of shaded apertures in the I.Q.:

1. A series of apertures with a Gaussian transmission distribution will be fabricated with the total diameters of these apertures ranging from 0.4 mm to 2.0 mm in increments of 0.1 mm. These apertures will have an intensity transmittance at their edges of approximately 10% of their peak value. Mounts for holding these apertures in the aperture plane of the I.Q. will be supplied.

2. From the calculations which have already been performed for the IDT, the I.Q. apertures which are best suited for use with various film types which have undergone the available magnifications in the Projection Printer will be determined. For example, the appropriate aperture to use in the I.Q. for 8430 magnified 250 X in the Projection Printer should have the same scale as the IDT aperture for 8430 scaled up by a factor of 250. As Wiener apertures have been calculated for 3404, 8430, and Tri-X, the appropriate I.Q. apertures for these films can be determined for each possible magnification available in the Projection Printer. Traces of grain-limited imagery (made by contact printing) will be made using the aperture selected by this method, and also using apertures close in size to the indicated optimum aperture. These traces will be analyzed to establish the validity of this procedure for selecting the optimum aperture.

The apertures selected in this way will be the optimum apertures when grain-limited imagery is analyzed. A certain amount of grain noise will therefore still be in evidence when they are used, inasmuch as they provide an optimum tradeoff between signal and noise rather than reduce grain noise to a negligible amount. When lens-limited imagery is analyzed, a larger shaded aperture can be used to reduce grain noise further without limiting resolution. Experiments will therefore be performed to establish guidelines for choosing the proper aperture in such cases. Enlargements of lens-limited images will be made in the Projection Printer. These images should ideally be representative samples of real-world imagery for which the resolution is known. These enlargements will be traced in the I.Q., first with the appropriate aperture for grain-limited imagery, and then with a sequence of larger apertures. The aperture which gives the most grain suppression without loss of resolution will be determined. Such an experiment will allow guidelines to be established for selecting the proper aperture to trace lens-limited imagery if the resolution of such imagery is known.

3. It is sometimes desired to make I.Q. traces of film types for which Wiener apertures have not been calculated. In such cases, it may be possible to select the appropriate shaded aperture by visually comparing the grain characteristics of the film to be analyzed with those of the films for which Wiener apertures have been calculated. This could be done by comparing the Projection Printer enlargement of the unknown film with enlargements of Tri-X, 8430, and 3404 made at known magnifications. If a good visual match in grain characteristics is obtained, the best shaded aperture to use in tracing the unknown film should be the same aperture that would be used with the known film at the enlargement at which the best match is obtained.

Experiments to test the feasibility of this approach will be conducted. A set of standard enlargements of Tri-X, 3404, and 8430 will be made on the Projection Printer by enlarging each film at each possible magnification. Imagery on a different type of film will then be enlarged in the Projection Printer and its grain structure will be compared to the standard enlargements to find the closest match. The shaded aperture corresponding to the matching standard enlargement will then be tried as a starting point in tracing imagery on the different film type, and other apertures close to this will also be tried. These traces will then be evaluated to determine if the optimum aperture can be selected in this way.